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ML program changes defense satellite industry

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WRIGHT-PATTERSON AIR FORCE BASE, Ohio — Never has the importance of defense satellites been greater than now. More are always needed, but technology and cost hurdles have served as roadblocks. That is until recently.

The Affordable Millimeter Wave Units (AMU) Program, which has achieved a rapid and highly repeatable automated assembly of module and board level AMUs, with minimal labor, and no hand tuning is revolutionizing the defense satellite industry.

The Air Force Research Laboratory's Materials and Manufacturing Directorate, under a cost-sharing contract with Northrop Grumman has developed the successful program, which is managed by the Manufacturing Technology (ManTech) Division. The program applies new forms of automated packaging to Radio Frequency (RF) modules and millimeter wave units driving down cost, while also decreasing the size and weight of each unit.

Microwave and millimeter wave units for defense satellites have been extremely expensive in the past – sometimes totaling more than 20 percent of the cost of a satellite. Typical applications use these units in high quantities and they are quite expensive individually – as much as $50,000 per pound.

Defense satellite systems scheduled over the next few years will include more microwave hardware than ever before. Phased arrays will use thousands of microwave modules per satellite, and some satellite constellations will consist of as many as 20-30 satellites. Without less expensive microwave hardware, some of these key Air Force mission systems would be unaffordable. AMU's objectives were to sharply reduce the assembly and test cost of satellite microwave units by as much as 60 percent, and effect at least a 10 percent reduction in the size and weight of each unit. Early indications are that this technology will meet and surpass those objectives.

Under the new automated process, AMU's modules and units require no hand tuning due to the precise assembly procedures and an optimum radio frequency (RF) design. The new AMUs also include more printed components that further reduce the part count and cost.

Key technologies for this program are the RF multiplayer boards that replace the previously required, and more expensive, cables, wires, coaxial connectors and simple passive components; integrated ring-frame module housings that are formed of a microwave substrate with printed traces and components, a ring, and a flat cover. Also, RF ball grid array modules are used that can be surface mounted to an RF multiplayer board in a single re-flow step, eliminating coaxial connectors and cables.

AMU has successfully demonstrated hardware designed specifically for three major defense satellite system programs. Near term space systems, such as the Transformational Satellite, and the Space-Based Infrared System Low and Advanced Extremely High Frequency (AEHF) have had estimates placed that show that AMU's technologies will save 50-80 percent of the cost of tens of thousands of modules, which previously would cost several thousand dollars apiece. The AEHF, for example, is now well along in development and has adopted and inserted AMU's technologies in more than 100 RF board assemblies and nearly 10,000 RF modules.

The AMU Program has shown a 90 percent reduction in hardware, 65 percent reduction in parts cost, a 50 percent reduction in board size and weight and a module yield greater than 95 percent in 19 GHz boards with 37 modules and 64 connectors.

The production improvements provided through the AMU program will produce significant cost avoidances for critical Air Force satellite programs and may make the difference in whether or when specific systems and military capabilities become available to the warfighter. @